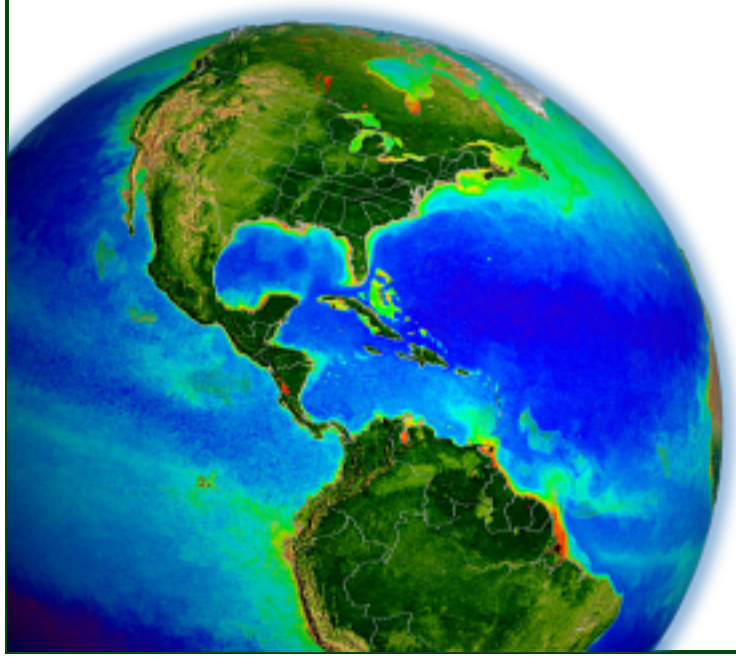
Updates to the On-Orbit Calibration of SNPP and NOAA-20 VIIRS for Ocean Color Applications



Gene Eplee, Gerhard Meister, Fred Patt, Kevin Turpie, Sean Bailey, and Bryan Franz

NASA Ocean Biology Processing Group

MODIS/VIIRS Calibration Workshop
February 25, 2021

On-Orbit Calibration Updates

- Applying linear beta-angle corrections to solar f-factors:
  - Removes residual beta-angle effects in solar observations.

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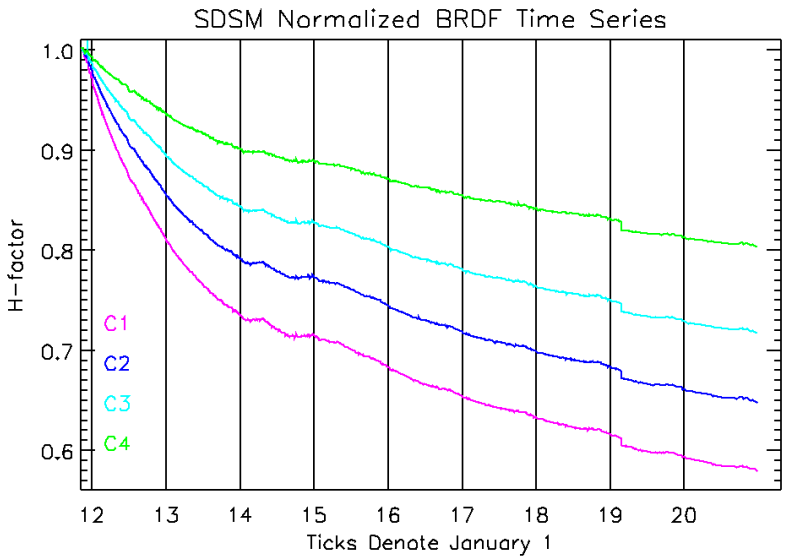
- Using solar-derived f-factors to calibrate lunar observations:
  - Fits to the calibrated lunar time series have smaller uncertainties than computed differences between the solar and lunar time series.

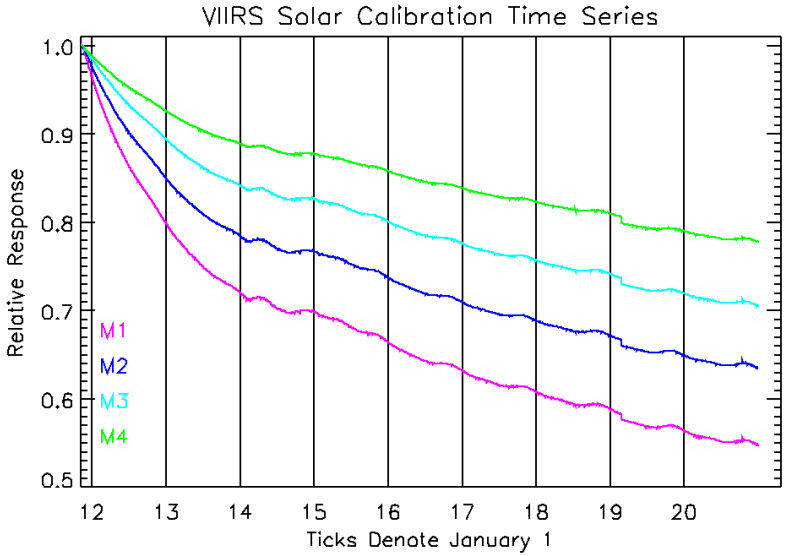
- Using long-period exponentials as basis vectors for radiometric fitting to the lunar time series:
  - Simultaneous linear fits of lunar time series by exponentials and libration angles minimize any impact of libration on the radiometric fits.
  - Lunar gains are the exponential component of the fits.
  - Lunar gains applied to solar-derived F-factors for bands M1-M4, M8, M9

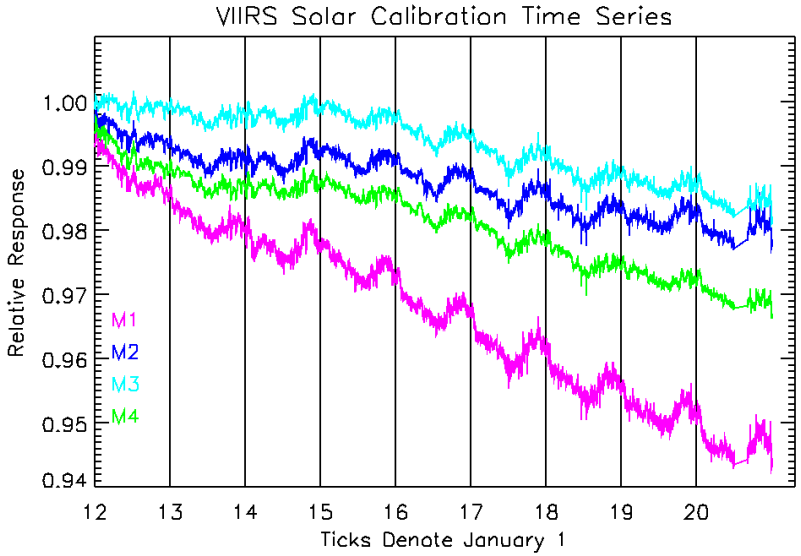
- Deriving modulated RSR gains from TOA ocean, lunar, and solar reference spectra for SNPP:
  - Band-averaged radiances computed for reference spectra and mRSRs distributed over the mission.
  - Gains derived from exponential fits to radiances, starting at first light.
  - mRSR gains are ratios of ocean and lunar or solar gains.

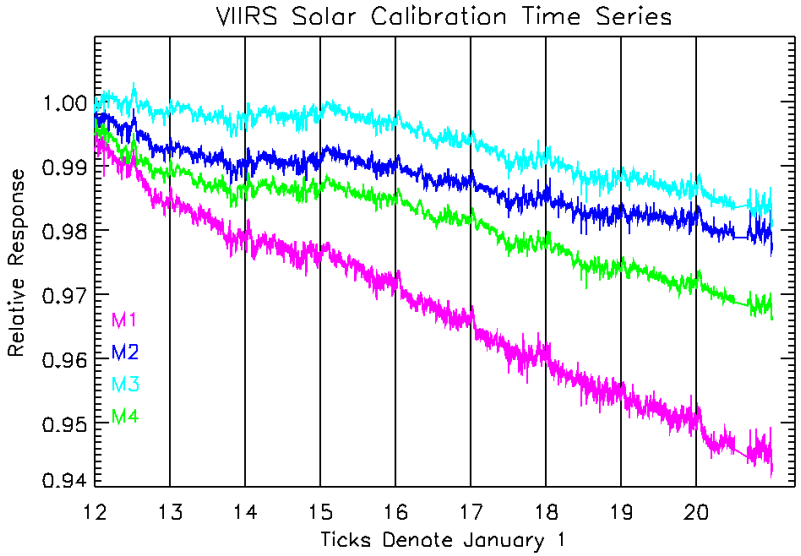
NPP Solar
Response Trending

Solar F-factors for Bands M1-M4

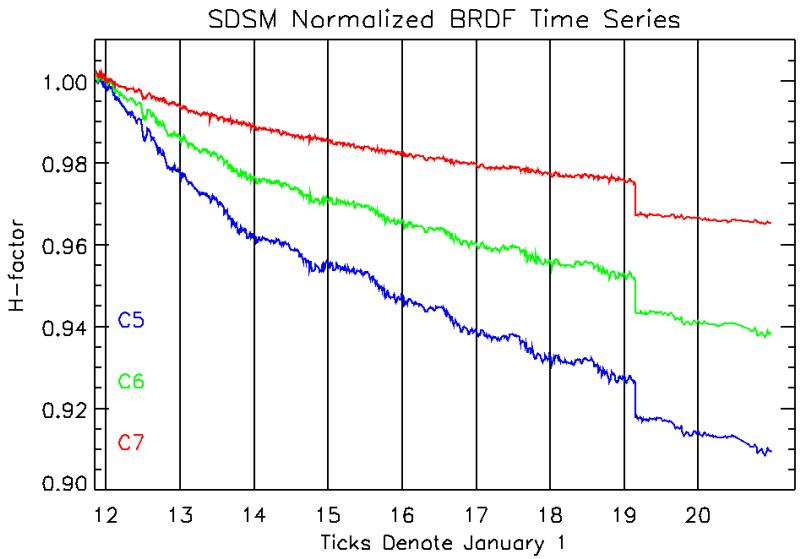


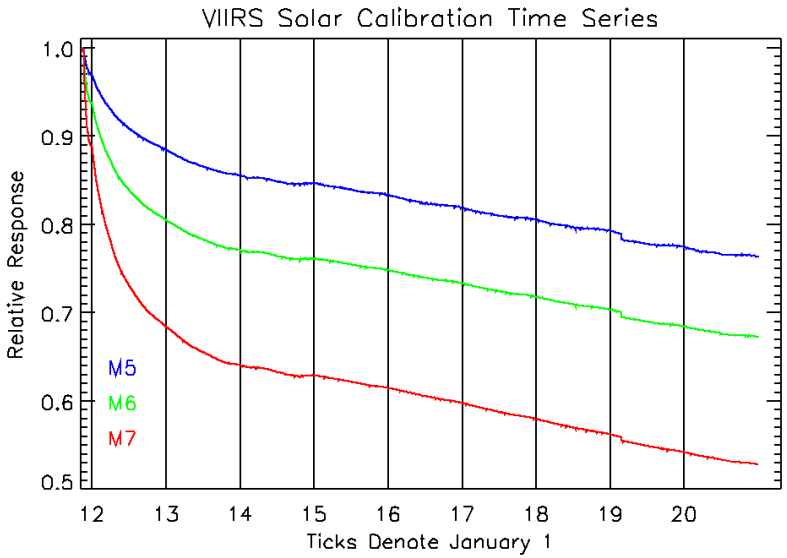


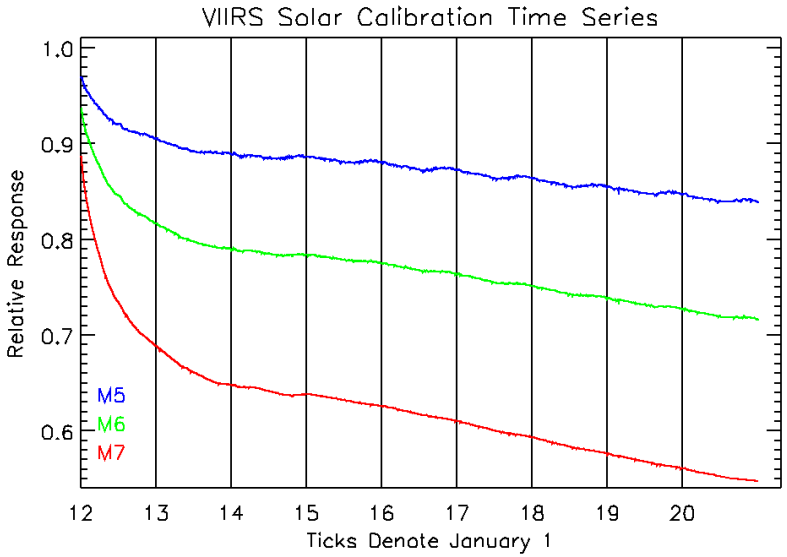


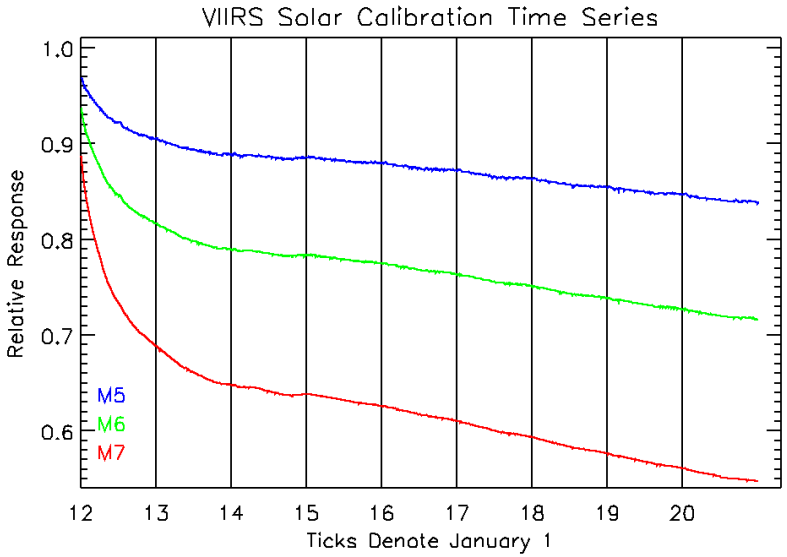


Solar F-factors for Bands M5-M7

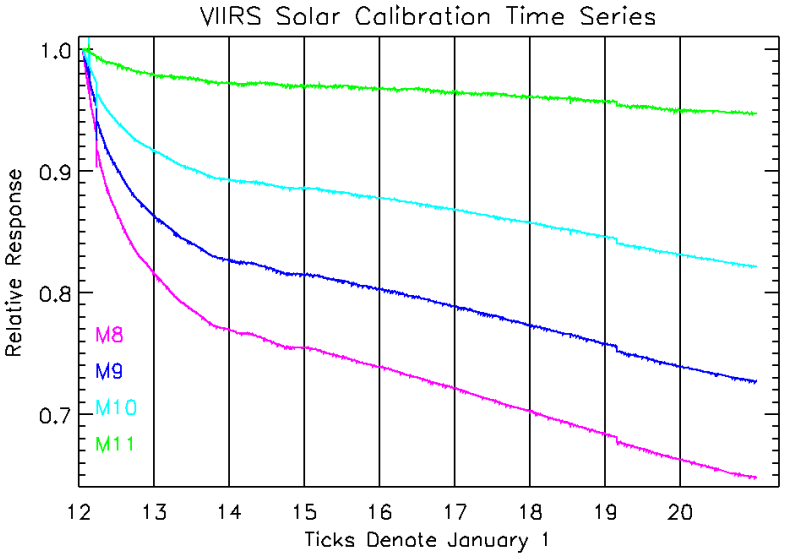


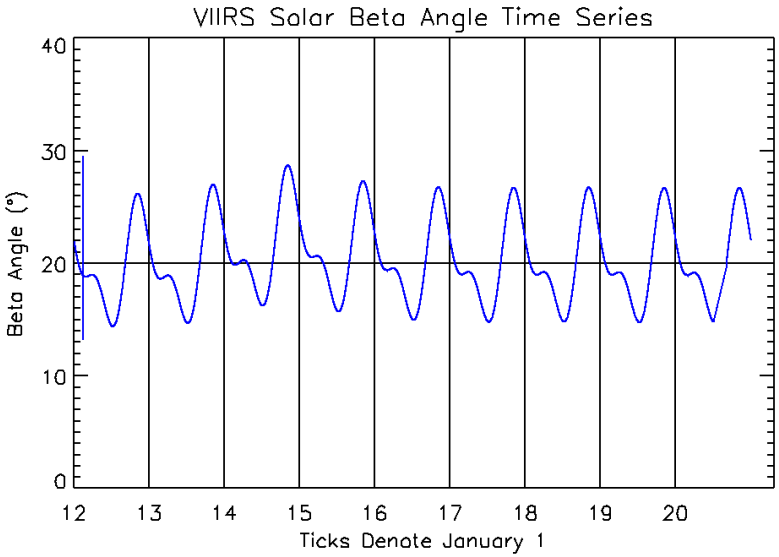


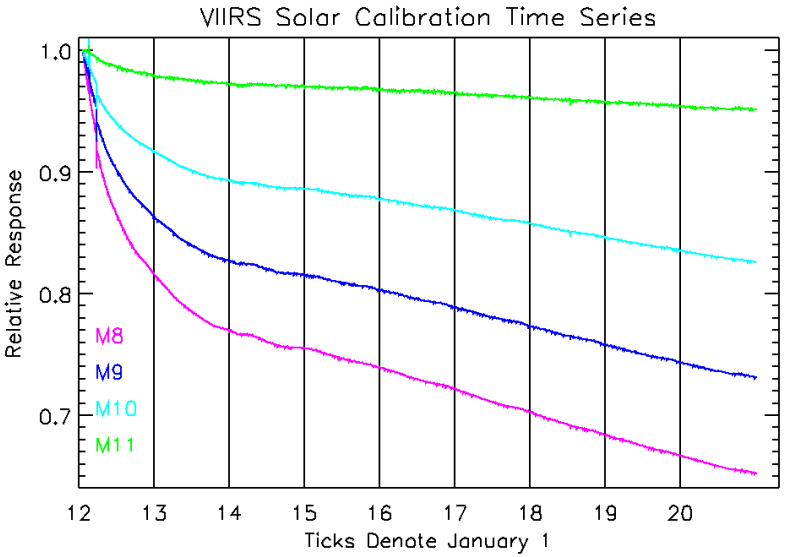




Solar F-factors for Bands M8-M11



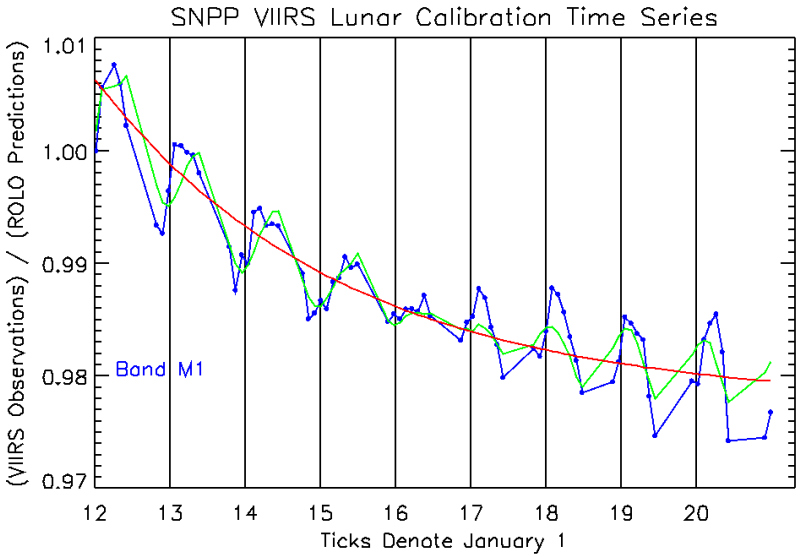


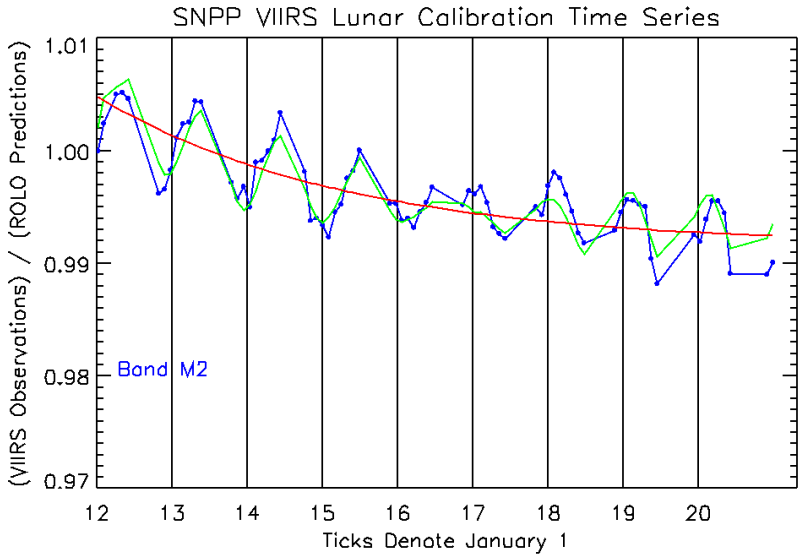


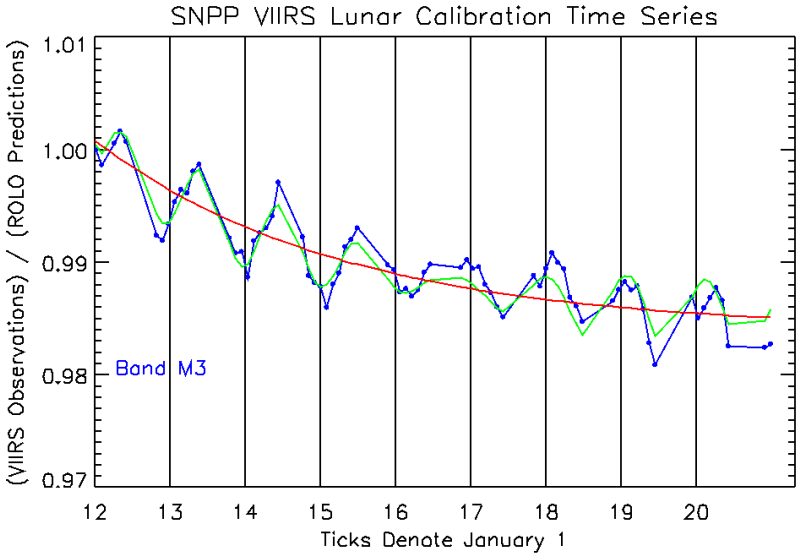
SNPP Lunar Response Trending: Solar F-factors Applied

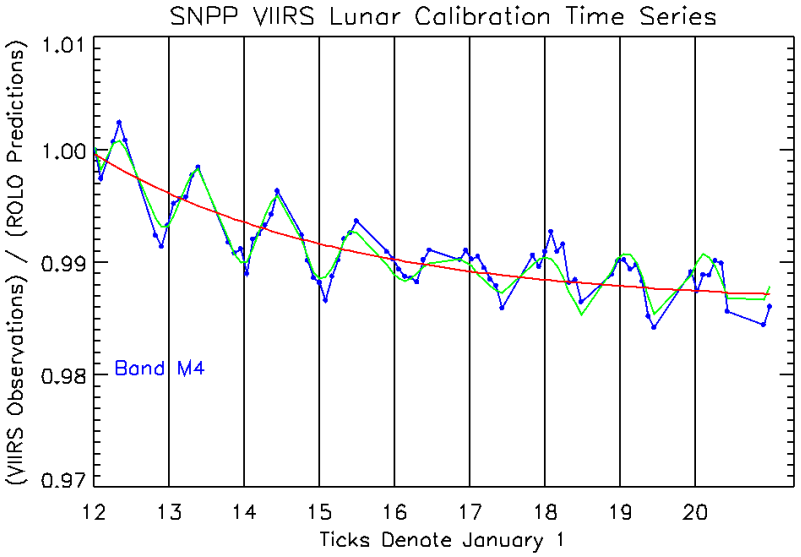
77 lunar cals
Jan 2012 through Dec 2020

Lunar Time Series Bands M1-M4

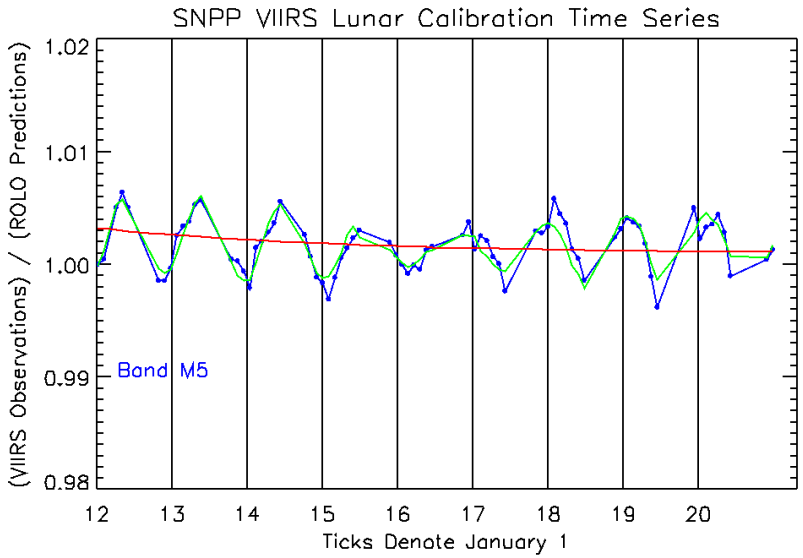


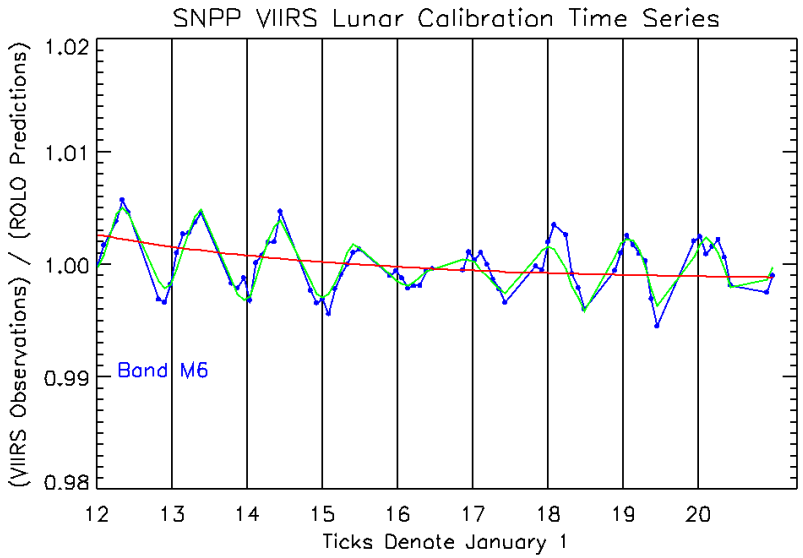


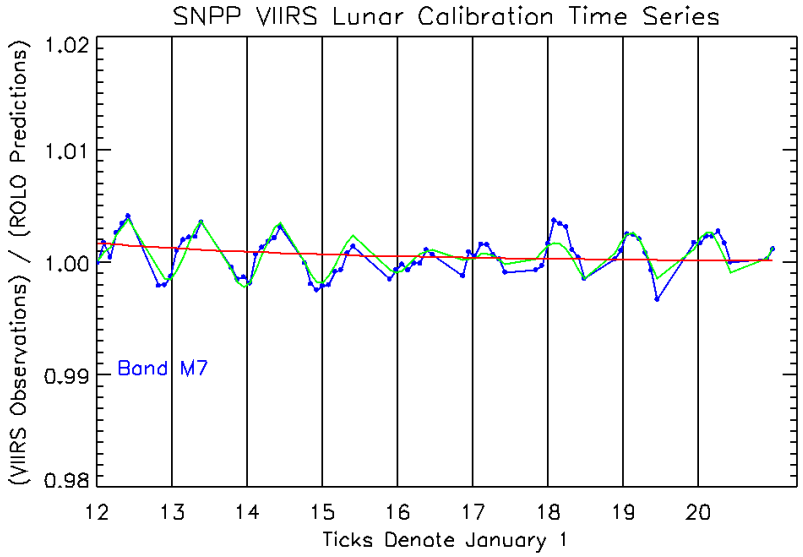


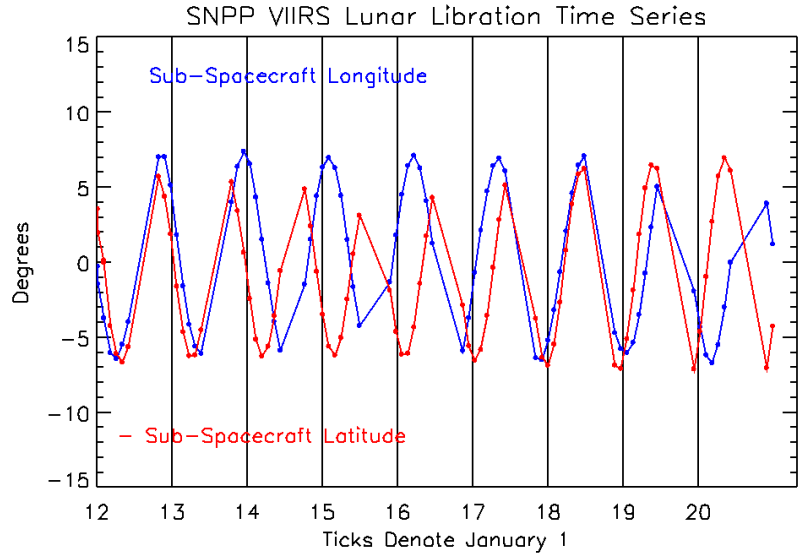


Lunar Time Series Bands M5-M7

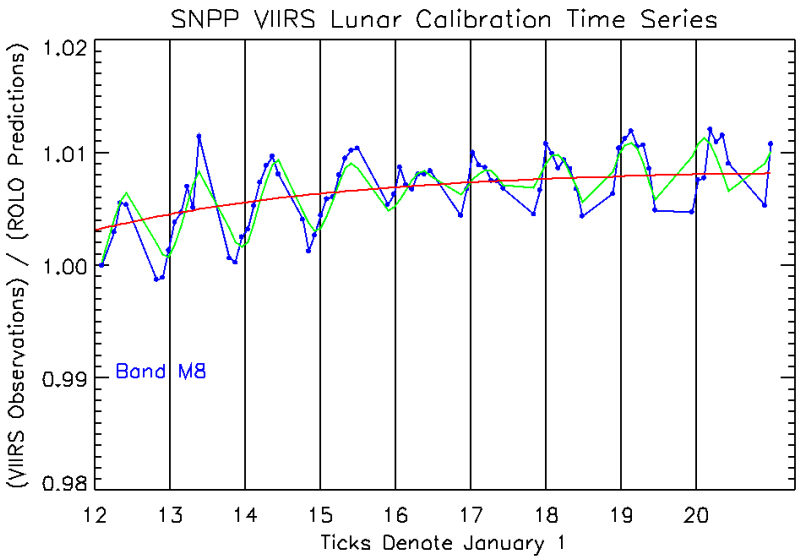


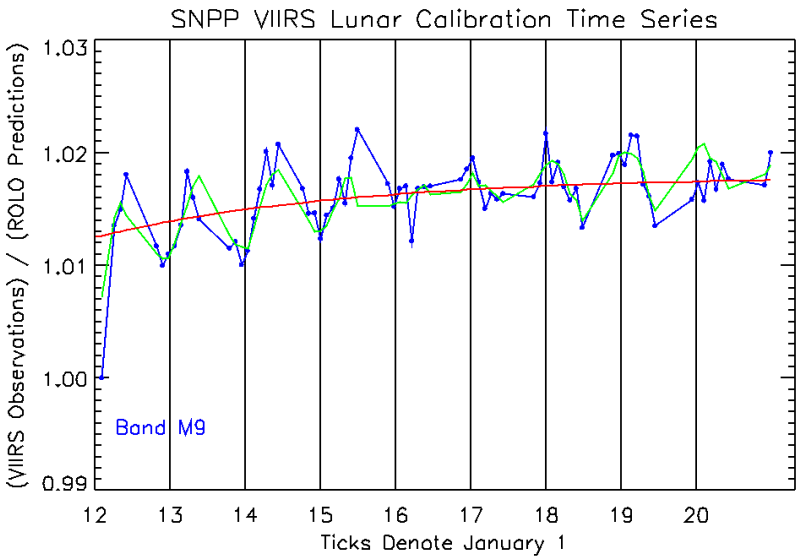


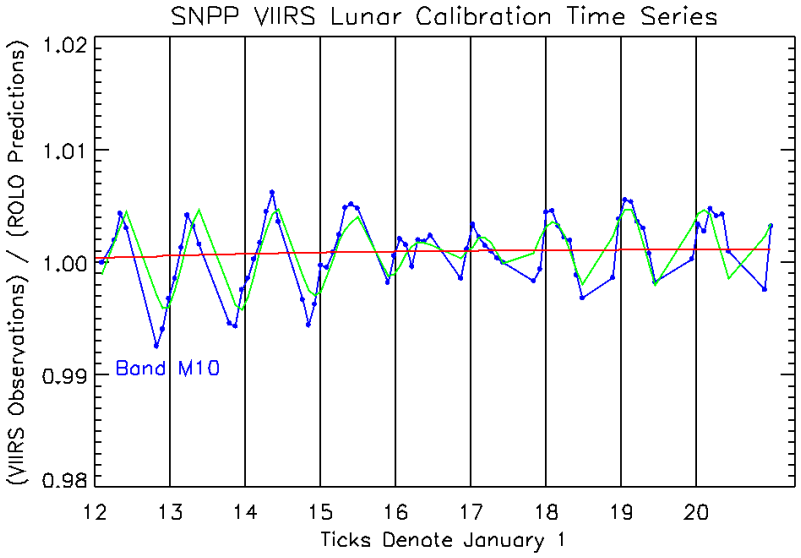


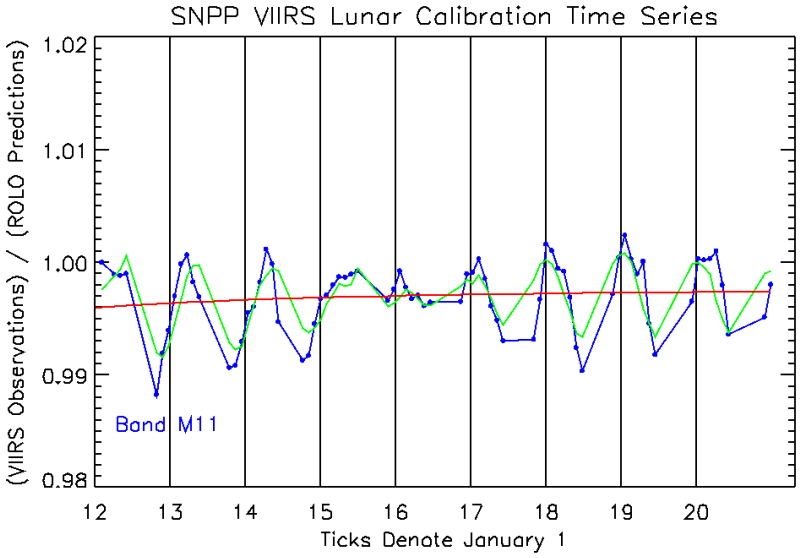


Lunar Time Series Bands M8-M11



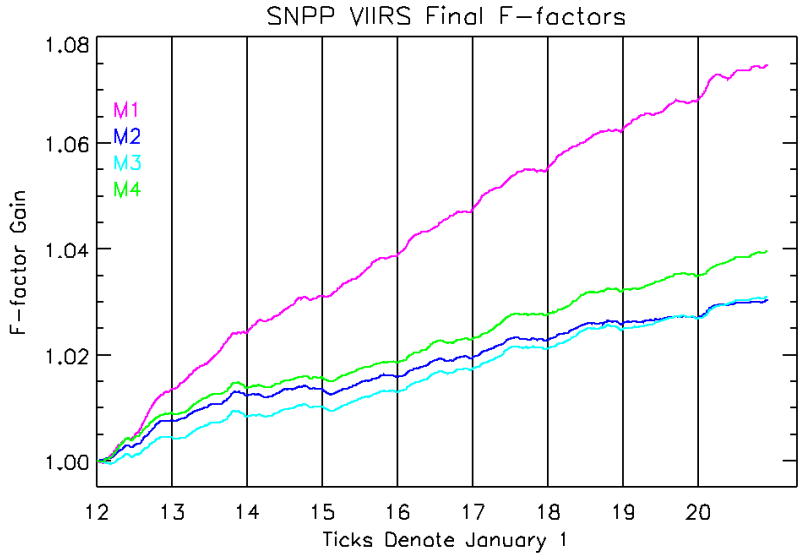


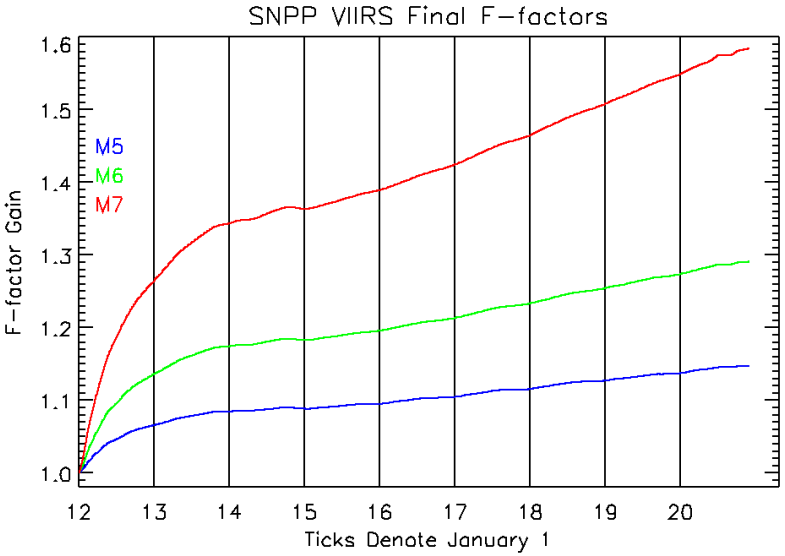


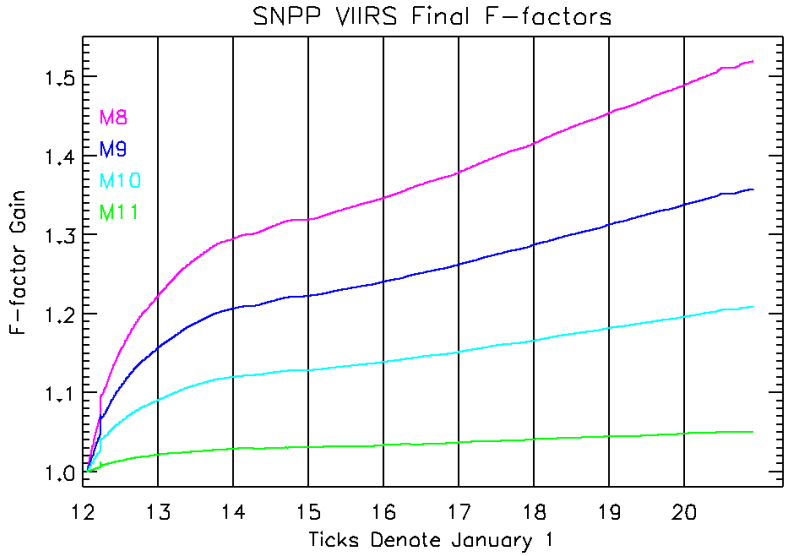


SNPP Final F-factors: Lunar and mRSR Adjustments to Solar F-factors

SNPP Final F-Factors

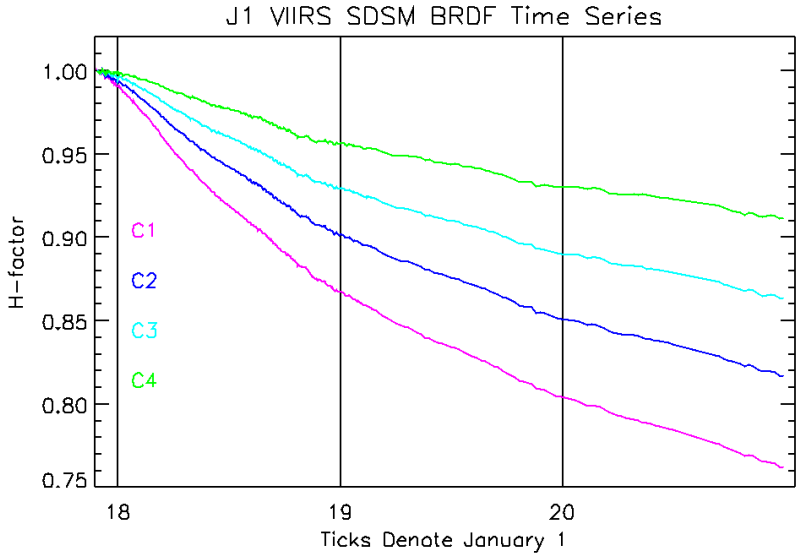


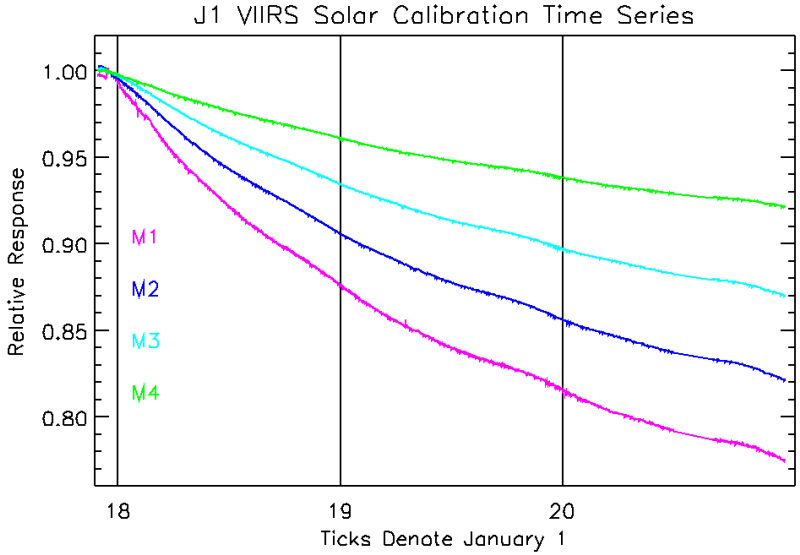


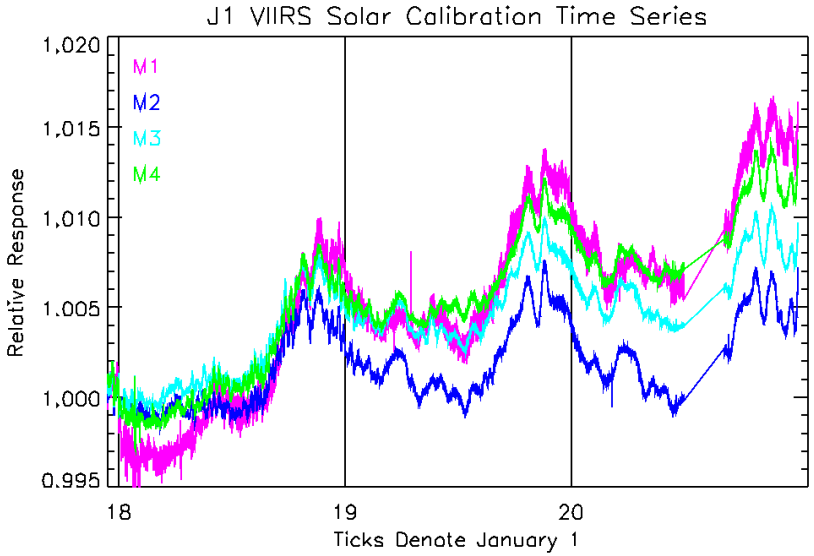


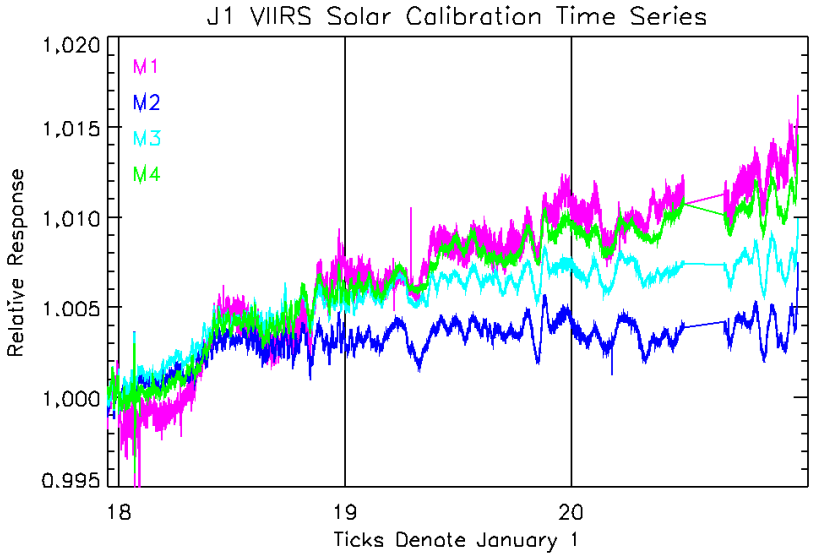
JPSS1 Solar Response Trending

Solar F-factors for Bands M1-M4

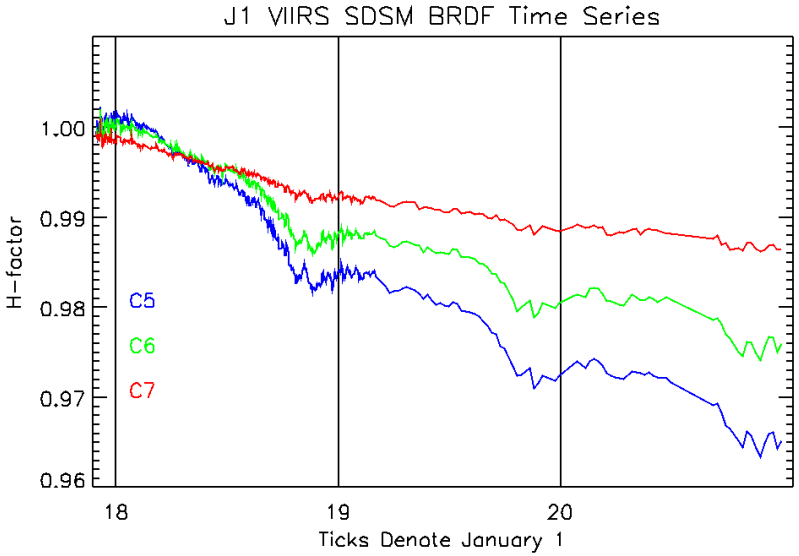


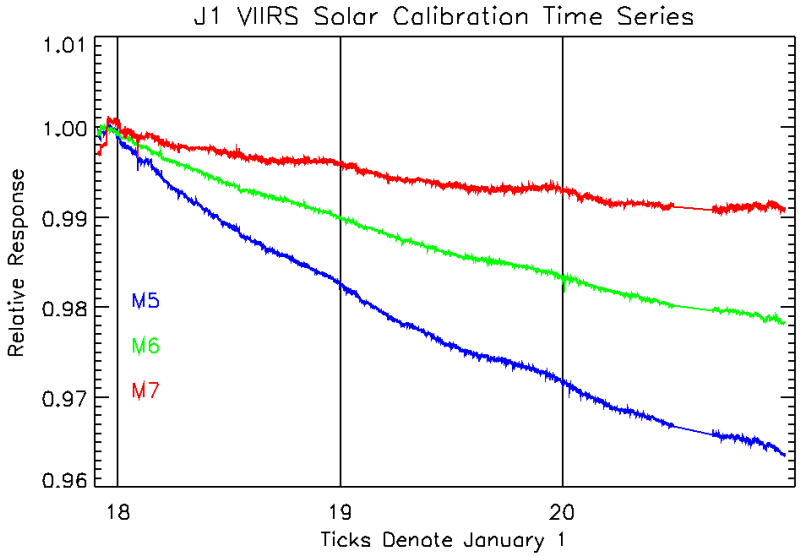


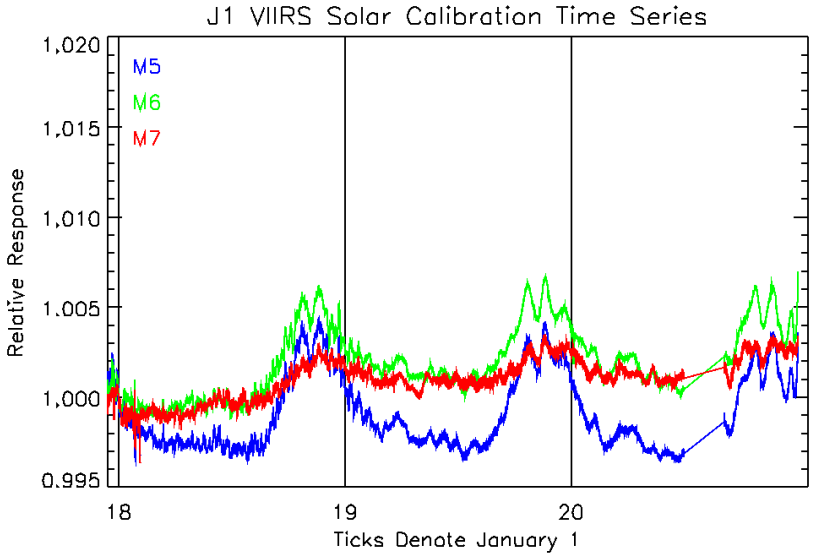


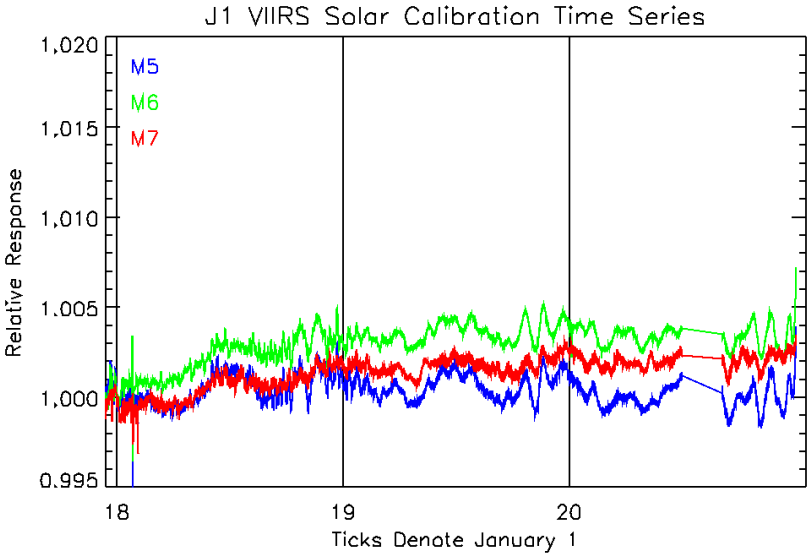


Solar F-factors for Bands M5-M7

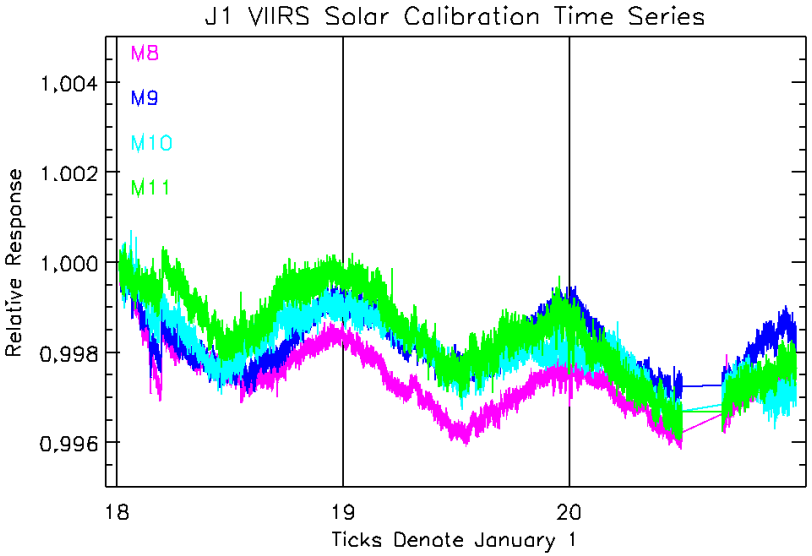


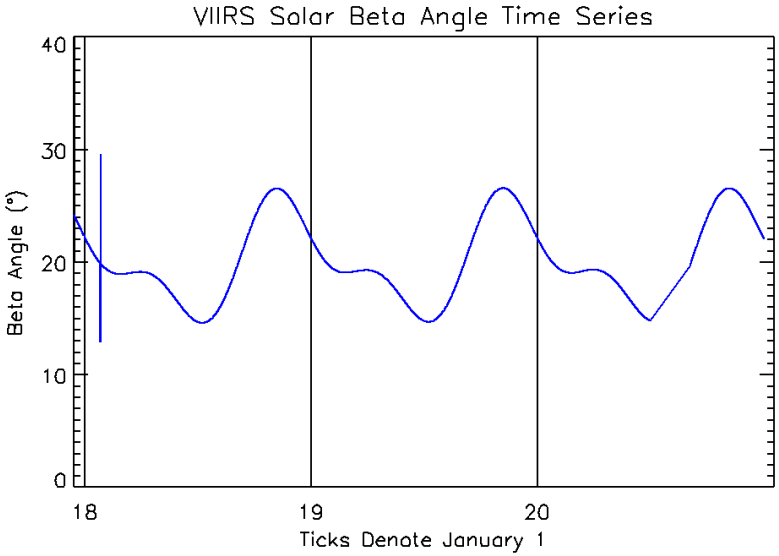


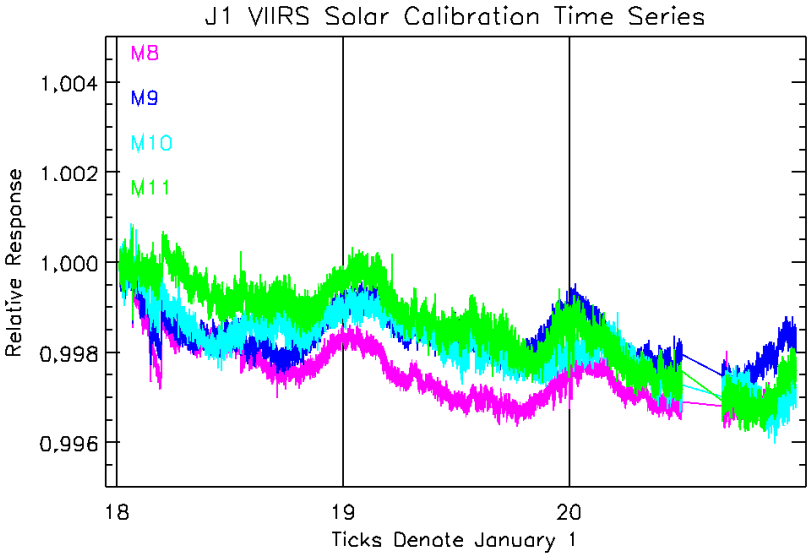




Solar F-factors for Bands M8-M11



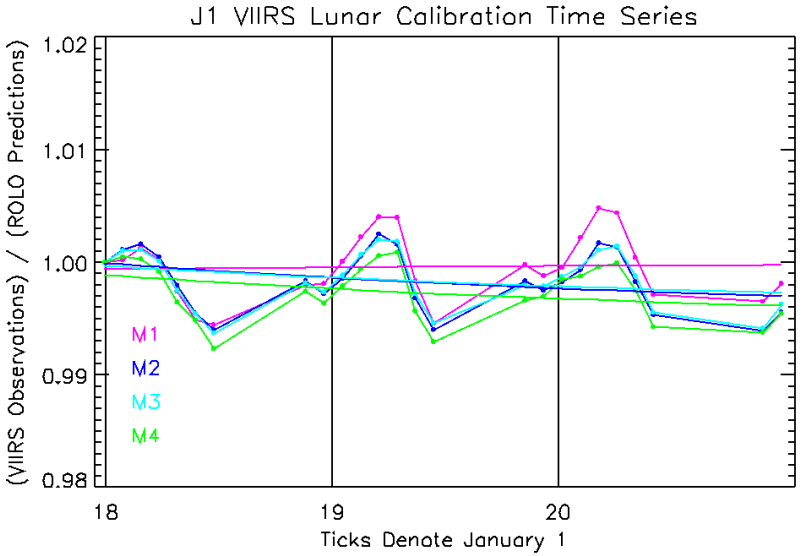


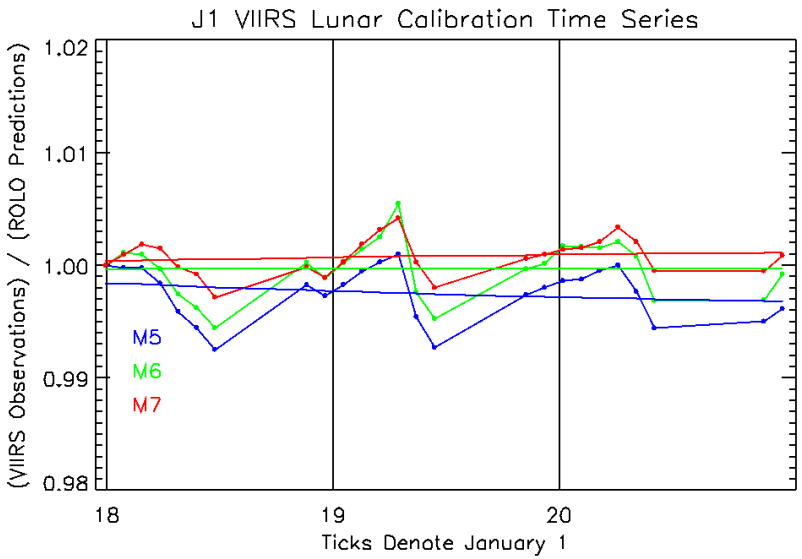


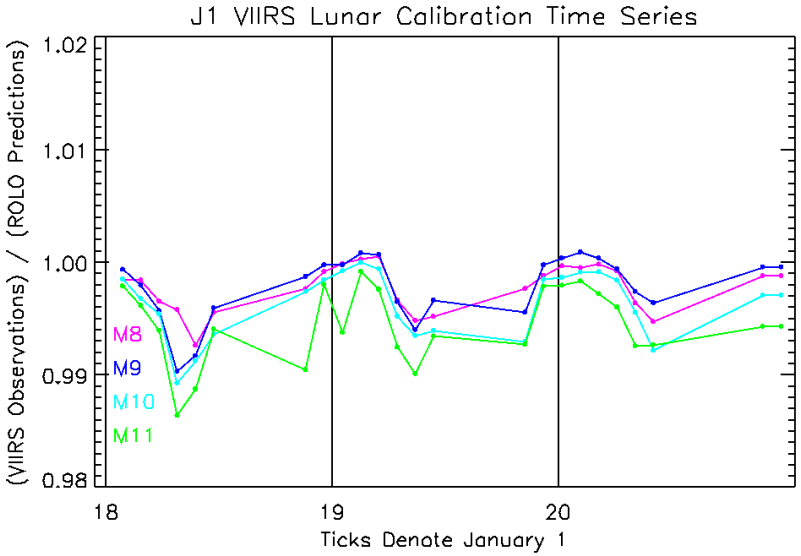
JPSS1 Lunar Response Trending: No Solar F-factors Applied

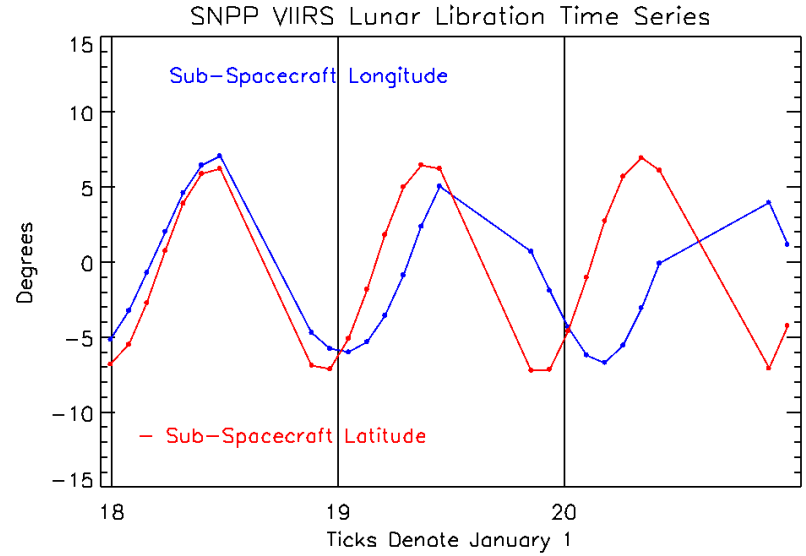
25 lunar cal
Dec 2017 through Dec 2020

Lunar Time Series

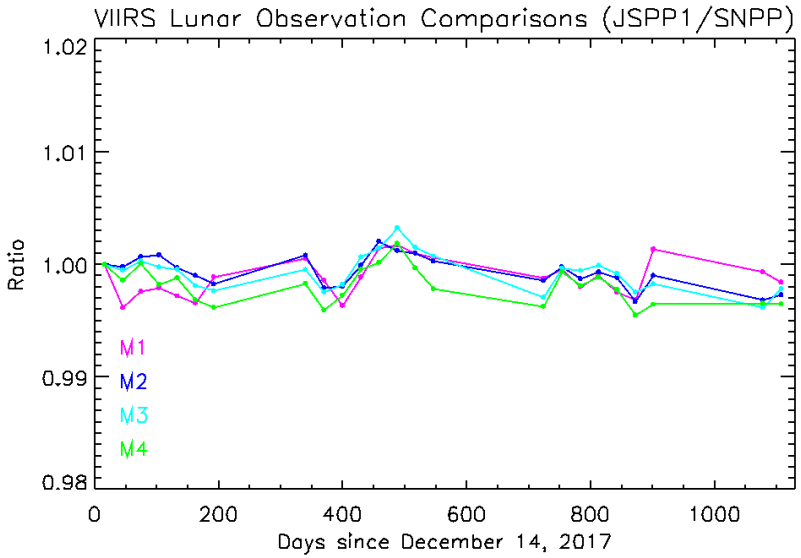


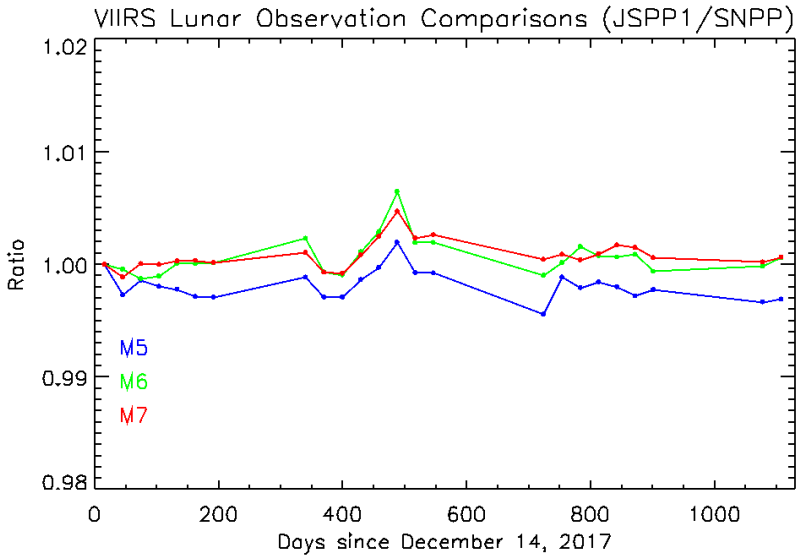


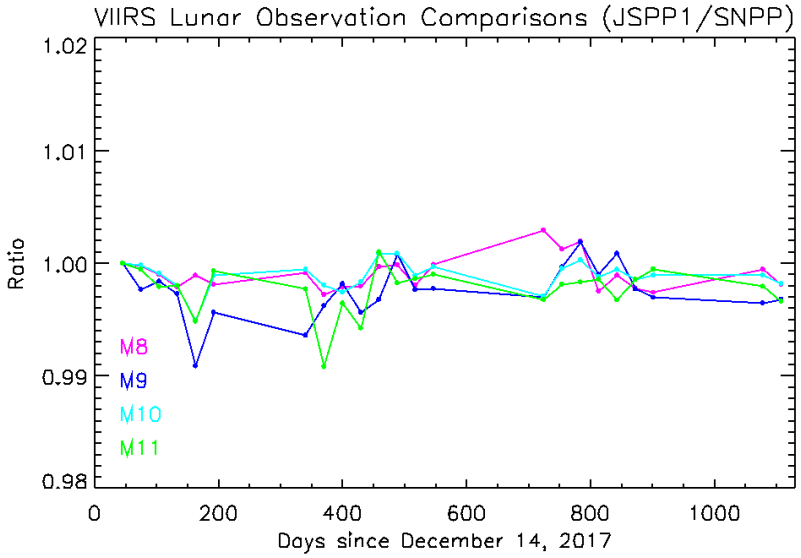




JPSS1/SNPP Lunar Time Series Ratios







SNPP Observations w/ Time Corrections

JPSS1 Observations w/o Time Corrections

JPSS1 Lunar Observations Show
No Significant Time Drift

Residual Libration Effects Cancel Out

SNPP / JPSS1:
Ocean Color Comparisons

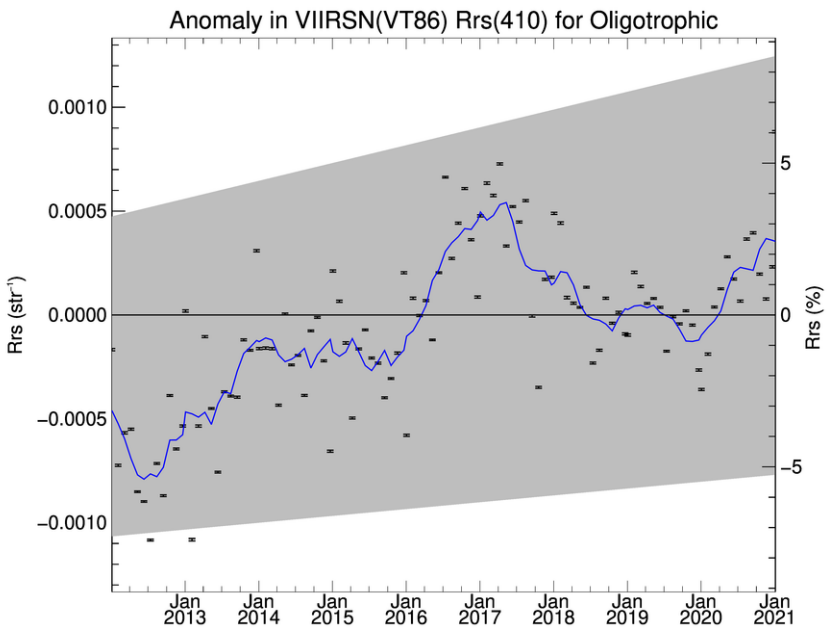
JPSS1 / SNPP Ratios

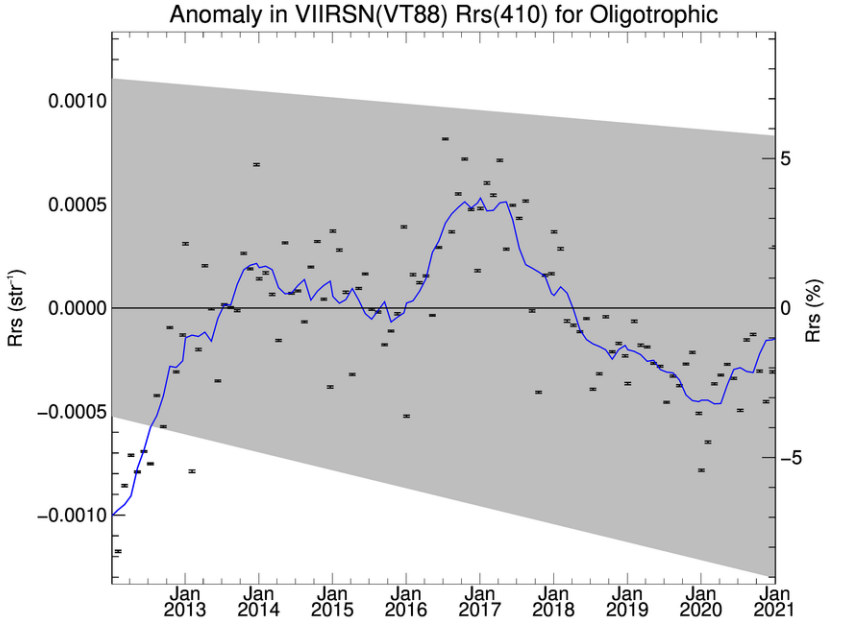
Band	OBPG Lunar Ratio	Vicarious Gain Ratio	VCST Desert Ratio	VCST SNO Ratio
M1	1.308	0.9442	0.926	0.938
M2	0.9467	0.9528	0.937	0.941
M3	0.9049	0.9612	0.956	0.951
M4	0.8842	0.9580	0.966	0.952
M5	0.9152	0.9680	0.952	0.957
M6	1.006	0.9825	--	--
M7	0.9426	--	0.973	0.968

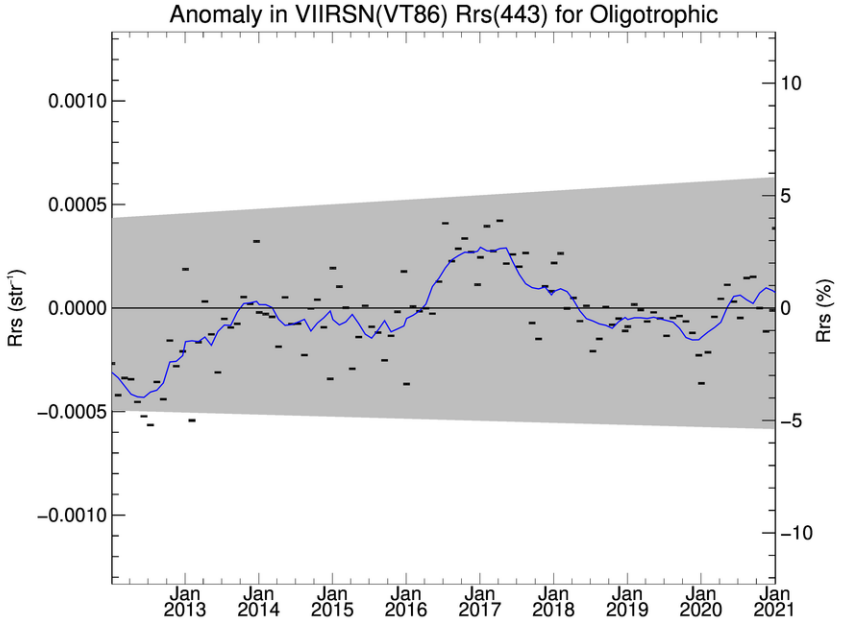
SNPP Ocean Color Anomaly Comparisons

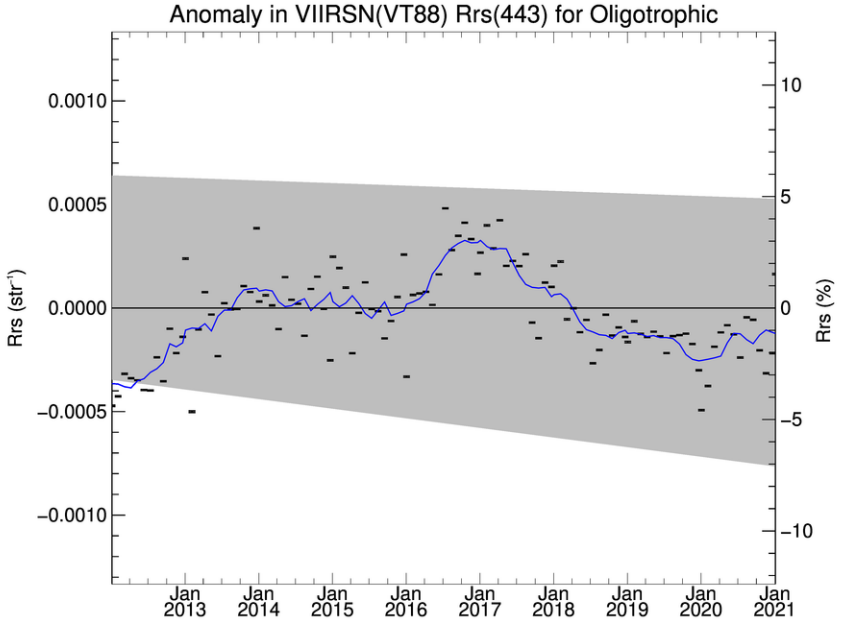
OBPG LUT: 2020160
VCST LUT: 20201223

Remote Sensing Reflectance Anomalies

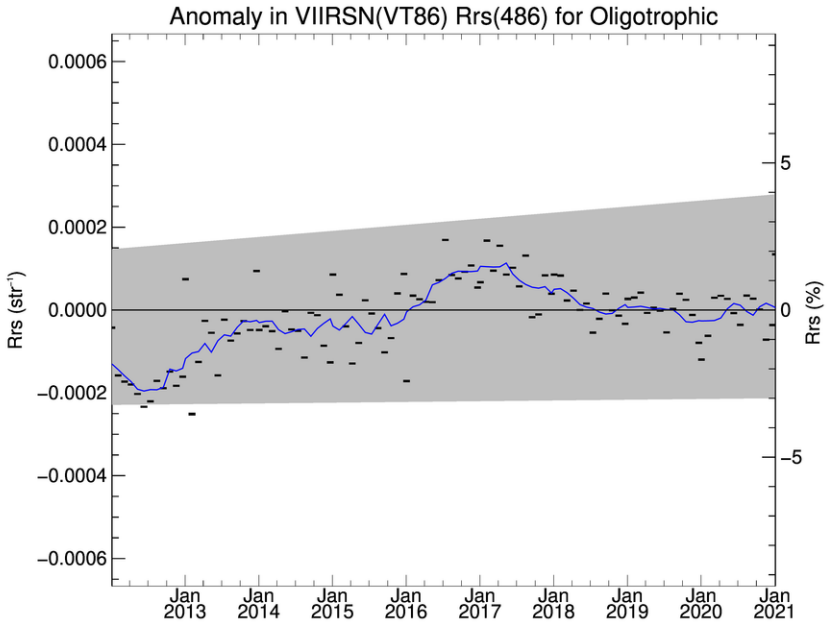


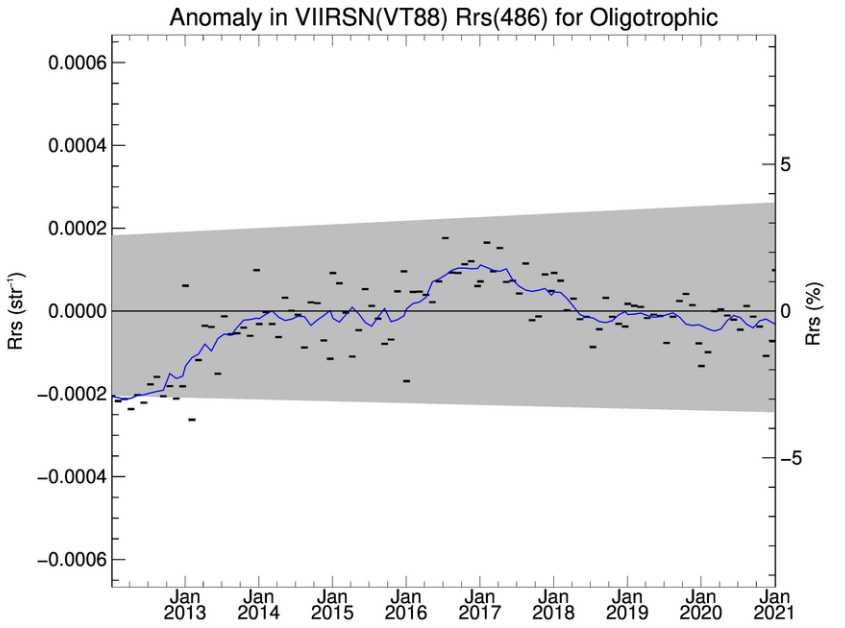


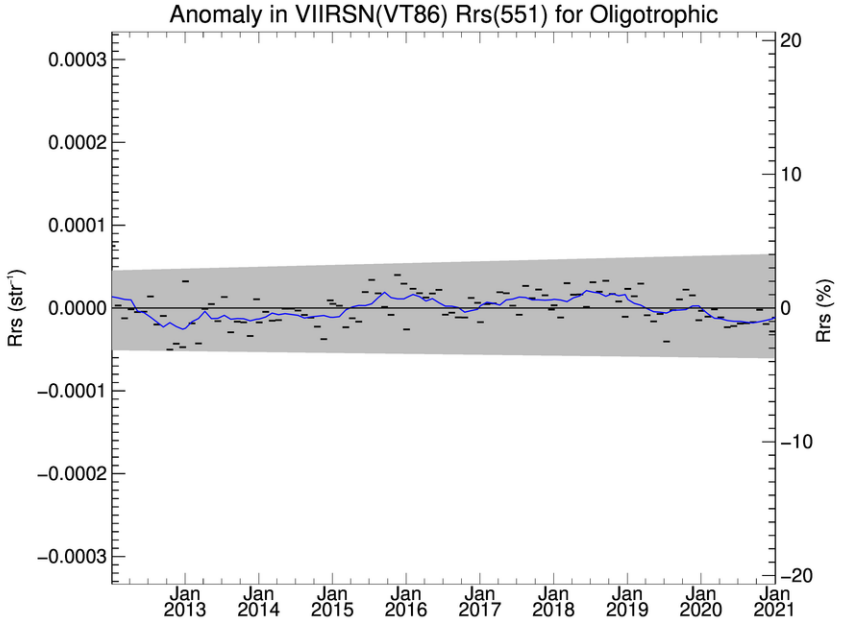


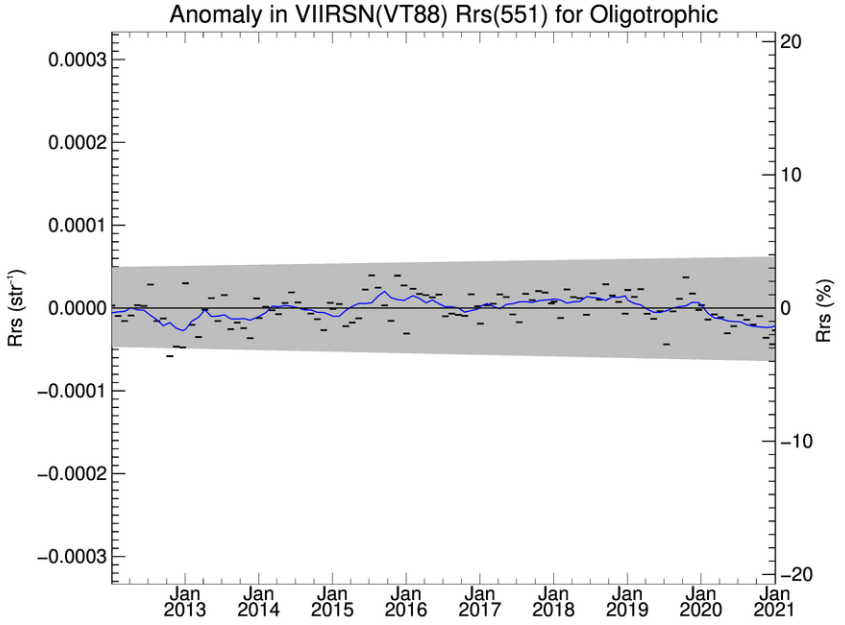


Remote Sensing Reflectance Anomalies

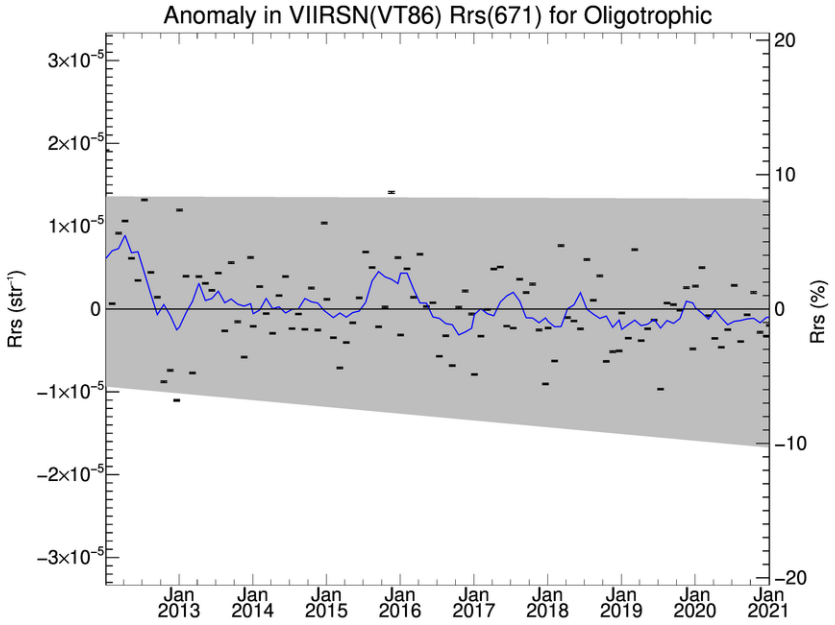


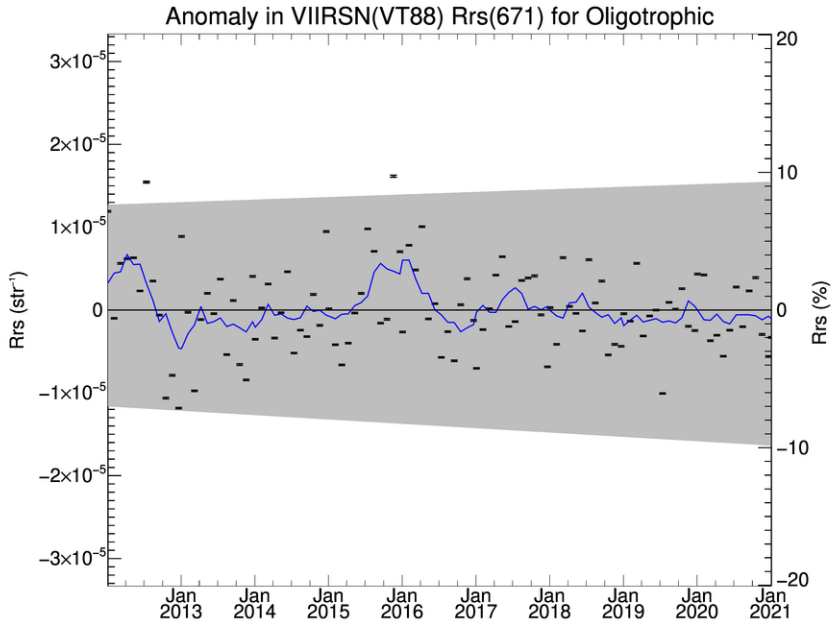


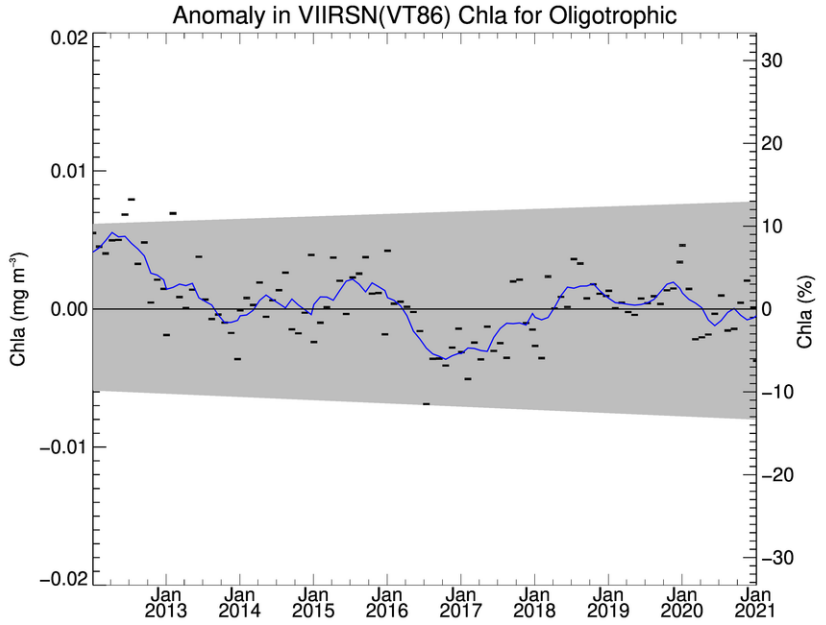


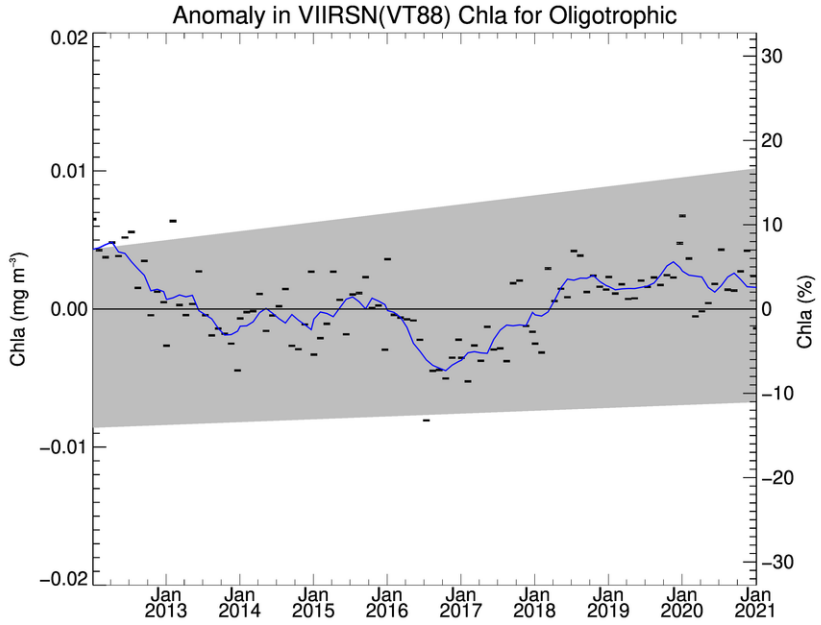


Remote Sensing Reflectance Anomalies





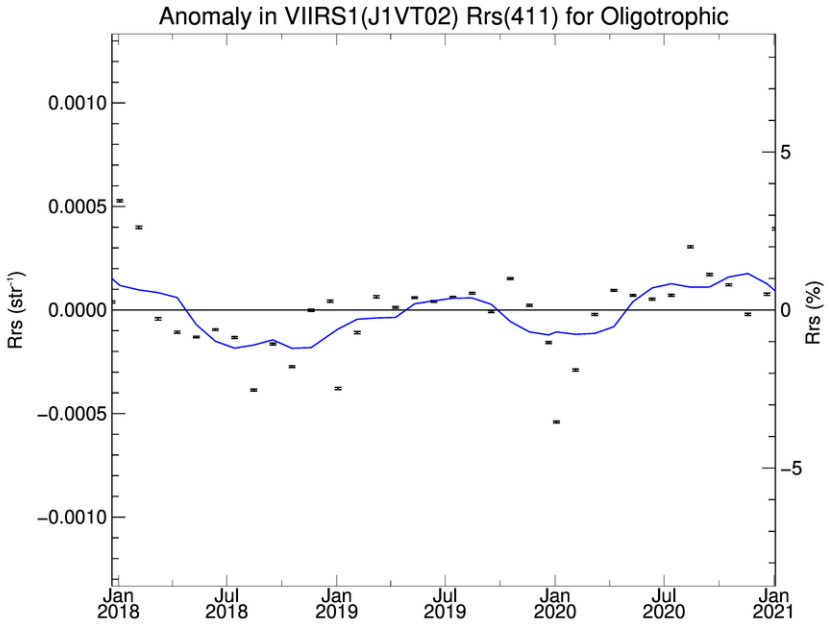


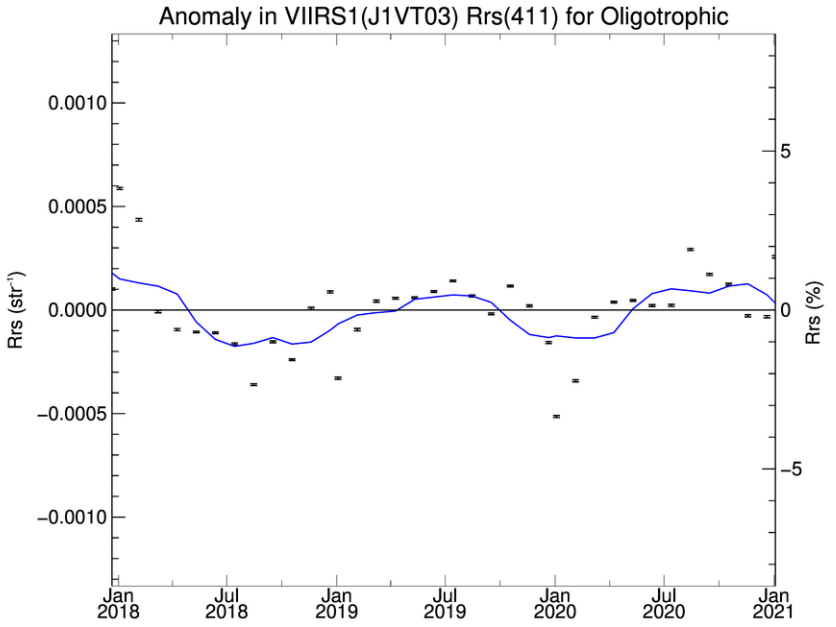


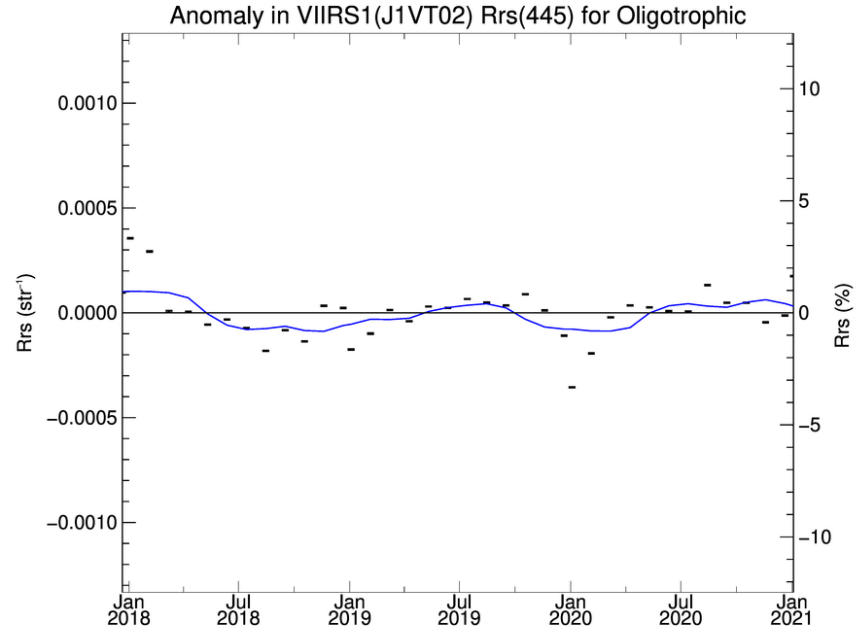
JPSS1 Ocean Color Anomaly Comparisons

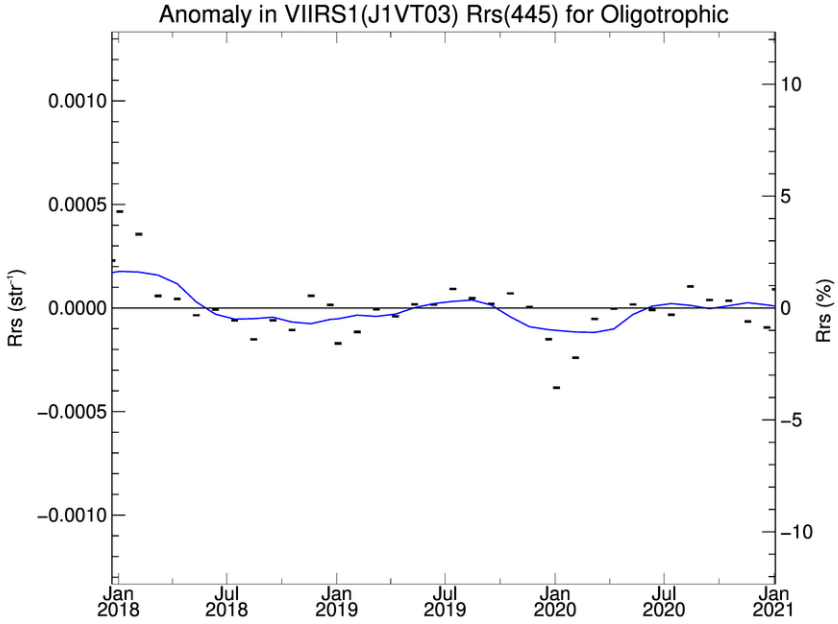
OBPG LUT: Static
VCST LUT: 20201210

Remote Sensing Reflectance Anomalies

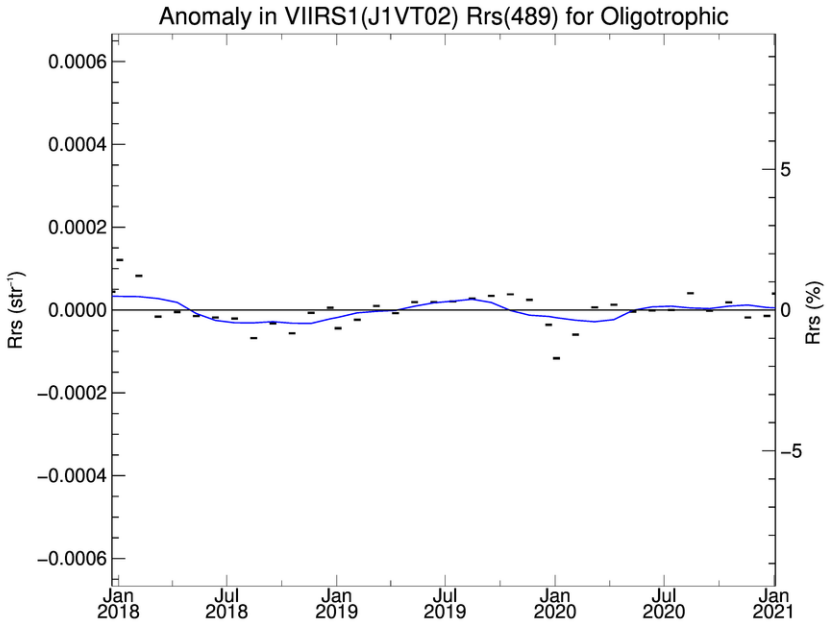


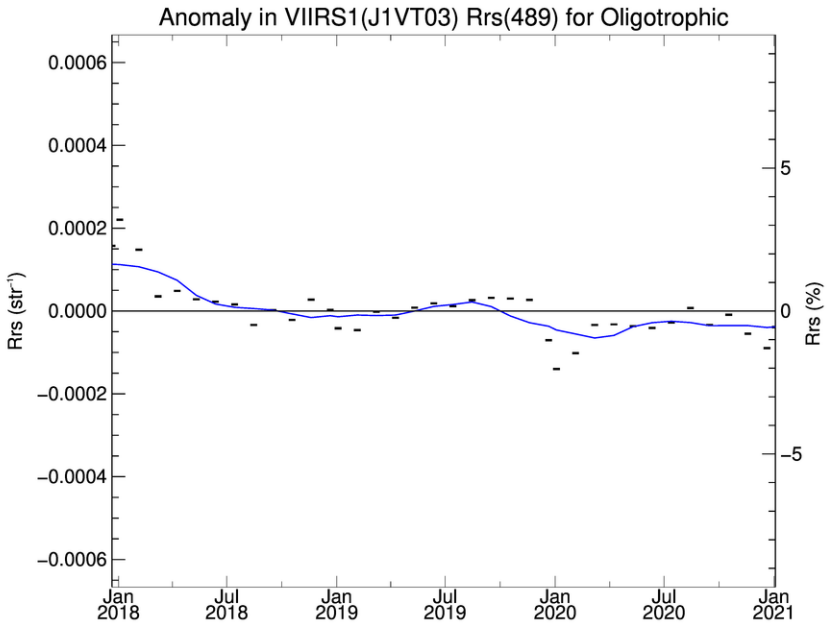


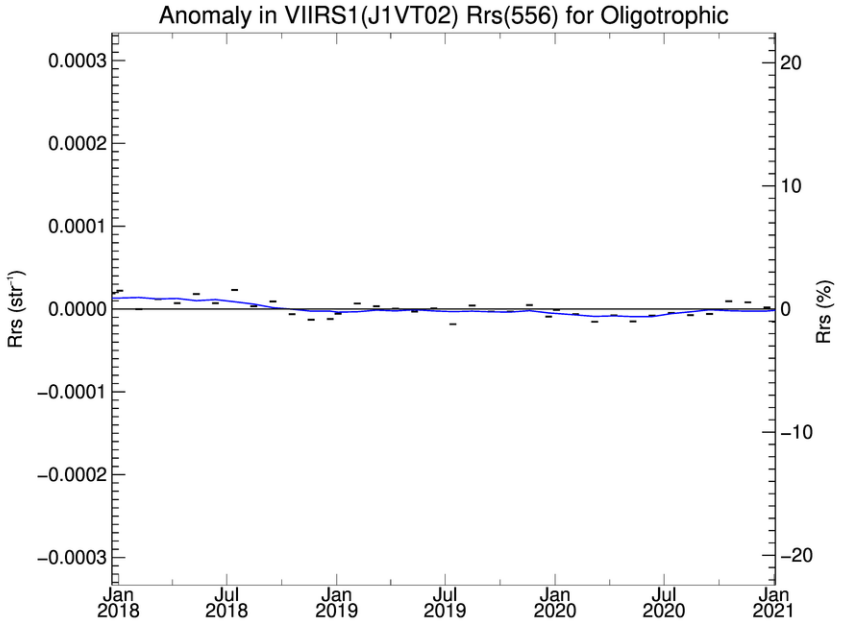


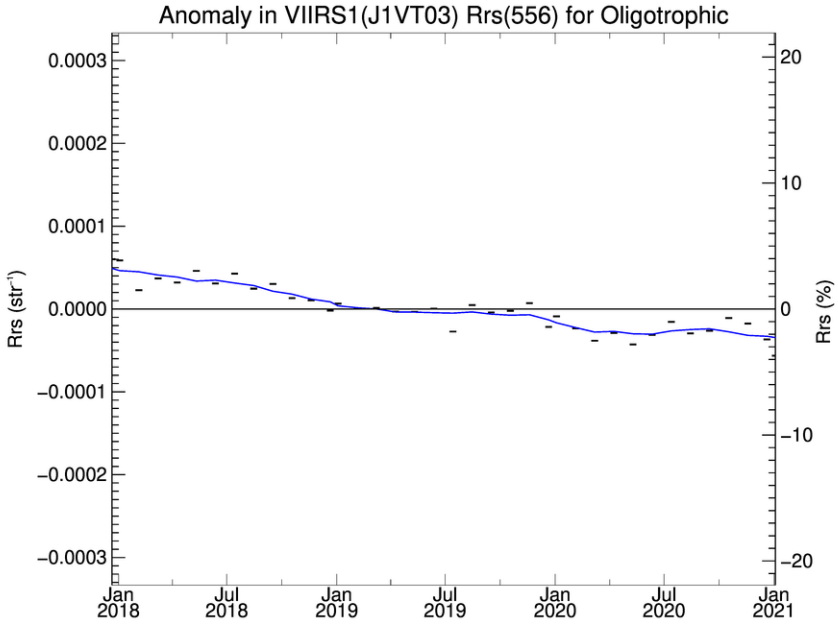


Remote Sensing Reflectance Anomalies

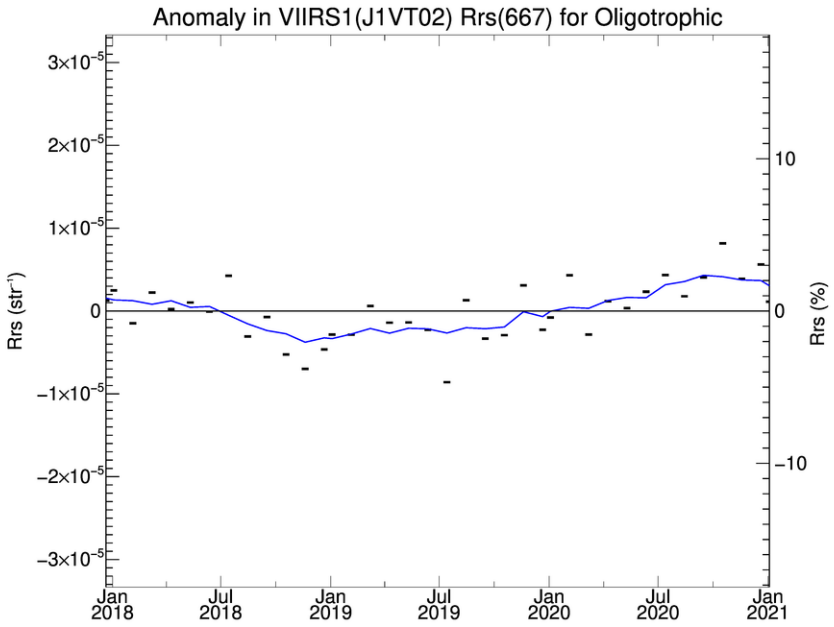


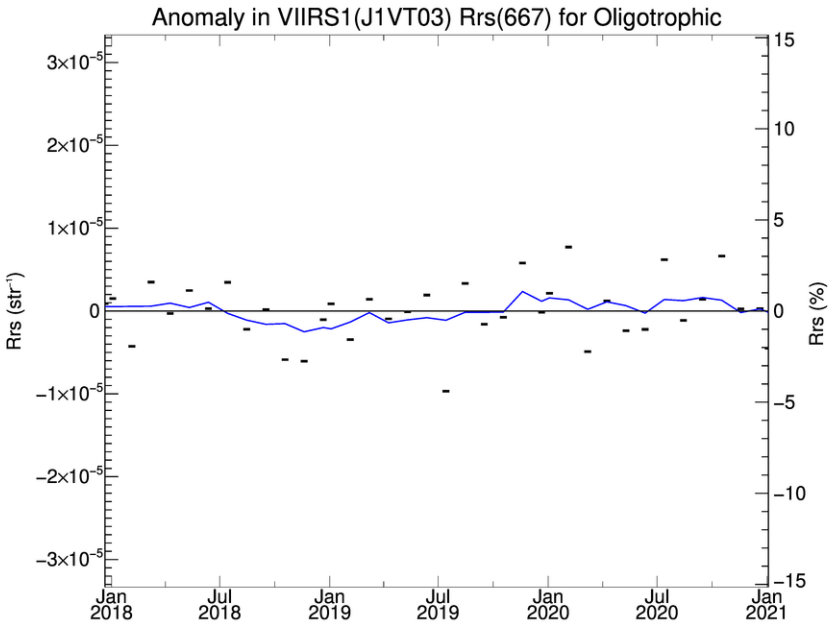


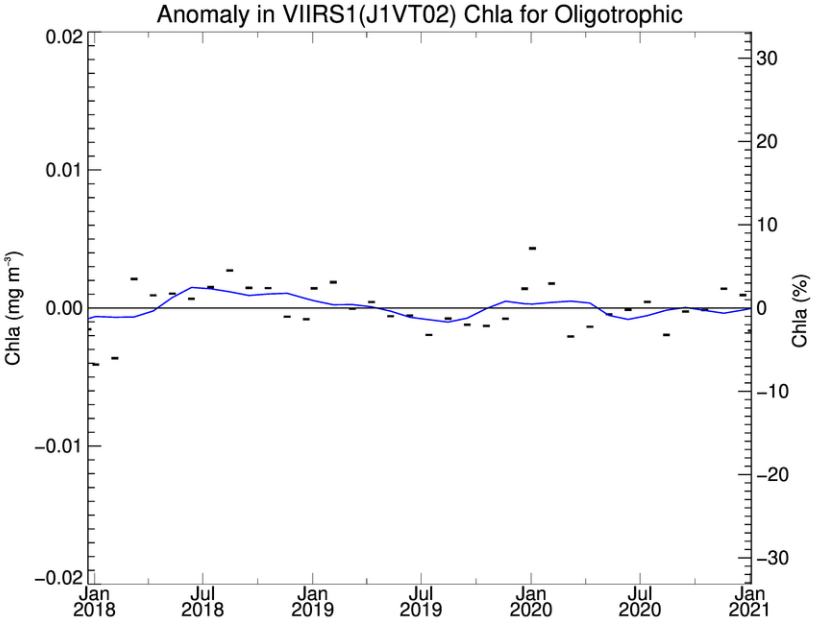


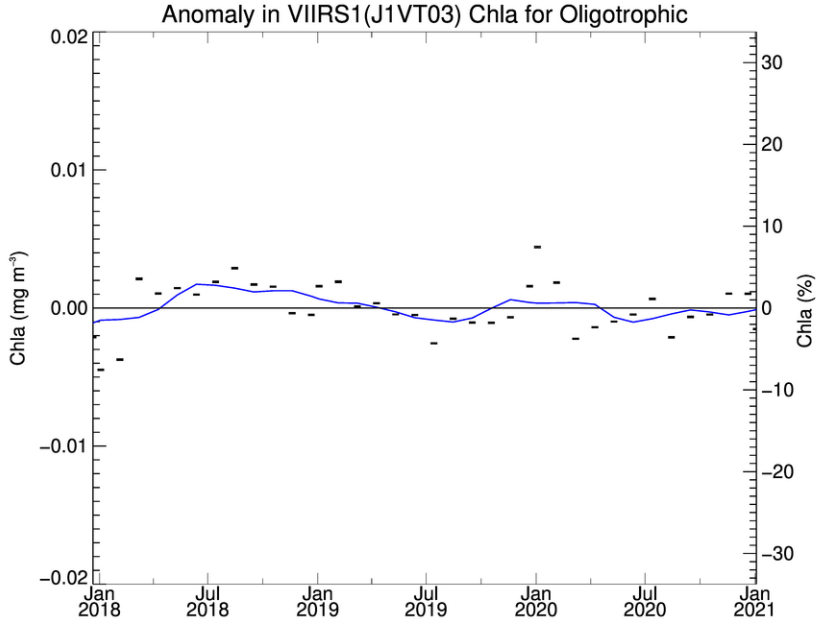


Remote Sensing Reflectance Anomalies









On-Orbit Calibration Summary

- SNPP: 79 lunar observations over 9 years (75 lunar cals for LUT)
  - Lunar gain adjustments to bands M1-M4, M8, M9
    - 0.7 – 2.1 % adjustments
- JPSS1: 27 lunar observations over 3 years (no temporal corr):
  - Solar observations show possible time drifts
    - ~1.5% in band M1, up to 0.8% in other bands
  - Lunar observations show no significant time drift
- JPSS1 / SNPP Lunar Observation Comparisons:
  - Residual libration corrections are similar
  - Lunar calibration ratios:
    - Residual libration effects cancel
    - No time drift for JPSS1
- JPSS1 / SNPP Remote Sensing Reflectance Comparisons:
  - JPSS1 R_{RS} are more stable over time than SNPP R_{RS}

Thank You